Botanical Club only, to one of the most interesting collecting grounds of the region, giving an opportunity to see the country and to botanize throughout the trip. The long excursion for Saturday has not been definitely decided upon as we go to press, but whether it be to the Saginaw valley or along the Detroit river an opportunity will be afforded the botanists to make a detour for examining the vegetation and collecting. The excursion after adjournment to Mackinac island and Sault Ste. Marie will give a rare opportunity to see a new flora and enjoy a delightful trip.

The meetings of the Club will be held during the week, beginning on Thursday (and not on Tuesday, the 25th, as erroneously announced in the Permanent Secretary's circular). The time and place will be given in the daily programme, as well as all other announcements for the Club.

It will doubtless not be superfluous to say a little regarding the organization and purpose of the Club. It had its inception at the Minneapolis meeting in a desire to secure a larger attendance of botanists at the meetings of the Association and to promote more ready and cordial intercourse between those who did attend. It was expected that accomplishing this much would lead the way to the consideration of questions and measures of scientific and practical importance. The Club is not encumbered with constitution, by-laws or formalities. Only members of the Association who express an interest in botany are eligible to membership, and the only other requirement is registration. The meetings are held at such times as will not interfere with those of the Association, usually at 9 to 10 a. m., on Thursday, Friday, and the succeeding Monday and Tuesday.

It is earnestly suggested that only botanical papers of considerable weight and importance be submitted to the general Association, and that all others be read before the Club, which will give them quite as good a hearing and the certainty of a more earnest discussion.

CURRENT LITERATURE.

Neue Untersuchungen über den Befruchtungsvorgang bei den Phanerogamen als Grundlage für eine Theorie der Zeugung. Von Dr. Eduard Strasburger. 8 vo. pp. xii, 176. 2 plates. Jena: Gustav Fischer. 1884.

The improvement in the processes of staining has made it necessary to re-examine some of the more recondite points in the process of fertilization of the Phanerogams, and Dr. Strasburger has gone over the whole ground thoroughly for the purpose of following the nuclei of the pollen grain thence to the oosphere. This has led him to the revision of the theory of fertilization.

The work before us is divided into five parts, the first treating of the structure and development of pollen grains and tubes; the second of the modes of penetration of the tubes into the stigma and the style; the third of the fertilization in the Coniferæ; the fourth of fertilization in the Angiospermæ; the last and largest part is devoted to a statement of a theory of fertilization. The following are some of the salient points of his work:

I. Doubt is cast on the generally accepted homology of the vegetative cell or cell-complex in the pollen grain of the Coniferæ and Cycadeæ with a rudi-

mentary prothallium, because the vegetative cells (when more than one) are cut off successively from the progamous cell. The proposition is then laid down that of the two cells formed by division in the pollen grain shortly before anthesis, the larger one is the vegetative and the smaller the generative cell, contrary to present nomenclature. It is found that there is in most cases a difference between the nuclei of these two cells in their capacity for taking up stains. Although in previous researches the nuclei had been thought to be sometimes absent in mature pollen grains, improved processes have demonstrated their presence in every plant examined. In ripe pollen grains the generative nucleus remains enclosed in the cell until the formation of the tube. In some cases the whole cell separates itself from the wall of the pollen grain, elongates and passes into the tube where it persists for some time. In other cases the generative nucleus divides while in the pollen grain, and this early division is characteristic of whole families, among which are mentioned the Gramineæ, Cyperaceæ, Juncaceæ, Caryophyllaceæ, Umbelliferæ, etc. The vegetative nucleus never divides, notwithstanding such division has been claimed be Elfving to occur in Cyperaceæ. When the pollen tubes are formed a strong streaming movement of the protoplasm carries the nuclei into the tube. The protoplasm keeps near the end of the tube and is prevented more or less completely from returning to the empty part by plugs of cellulose, except in a few cases. Usually the vegetative nucleus goes ahead, yet in many cases the generative one (or two) is first, and in other species sometimes one and sometimes the other. The generative nucleus in Angiosperms always divides once at least, and usually so in Gymnosperms. Both of the nuclei thus produced do not become destroyed, earlier negative results being due to imperfections in methods of research. The vegetative nucleus can be followed in monocotyledons to the ovule, although it frequently undergoes a surprising reduction in size. It is otherwise in dicotyledons. The vegetative nucleus disappears earlier or later in the pollen tube and only the two generative nuclei reach the ovule. This point is an important one; it strongly supports the claim that the smaller cell is the generative one; we must therefore consider the larger cell as the rudimentary prothallium in Angiosperms, a conclusion which increases the doubt as to the small cell or cell-complex of Gymnosperms being a prothallium. The author is somewhat inclined to consider the whole pollen grain of Phanerogams and the microspores of vascular Cryptogams as the homologues of the antheridia.

II. In studying the entrance of pollen tubes into the stigma several distinct modes were observed. The first case is that in which (in species of *Lilium*) the pollen tube grows downward on the one-celled club-shaped papillæ of the stigma, forces its way between their bases and enters one of the three narrow slits in which the canal in the style ends above. Through this canal, adhering to its walls in the mucilage formed by degeneration of the outer layer of the wall of the lining cells, they descend to the cavity of the ovary. In another case (*Atropa Belladonna*) the pollen grains drive their tubes between the cell-rows of the stigma and into the conducting tissue of the style which is arranged in several strands through it. In *Cereus speciosissimus* the conducting tissue surrounds a canal and the pollen tubes penetrate this and do not pass down the canal. In *Agrostemma Githago* the pollen tubes dissolve the walls of the elongated single-celled papillæ at the point of contact enter these cells and grow downward (though they sometimes make a mistake and have to turn on themselves) penetrate the bases of the papillæ cells and pass thereafter *between* the cells of the conducting tissue. The Malvaceæ behave in the same way as *Agrostemma*, though none of the rest of the Caryophyllaceæ agree with it. In *Anoda hastata* the pollen tubes penetrate the epidermal cells of the stigma (which are not at all prolonged, hardly even swollen) though the outer wall of these cells is somewhat cutinized! "[The pollen tubes] show in their be-

havior the same modifications as have been recognized for the penetration of the hyphæ of parasitic fungi into their hosts. The entrance of the pollen tubes *between* the cells of the stigmatic surface is most commonly observed and only in relatively few cases is their growth *into* the cell to be seen."

III. In the fertilization of the Coniferæ the most important morphological facts are clear. Differing from Goroschankin, Strasburger states that though he has seen numerous cases of copulation in *Picea vulgaris*, he has never observed more than *one* male pronucleus in this copulation. The second one is finally dissolved. The development of the oosphere of Abietineæ has been the subject of much controversy. The numerous nuclei of Goroschankin resolve themselves into vacuoles, according to our author. The nucleus of the central cell of the archegonium undergoes one division with which the formation of the canal-cell is connected. In Cupressineæ, as in all Gymnosperms, the male pronuclei enter the oosphere. They have previously been seen in the oosphere at various distances from the neck of the archegonium; lately they have been found at the extreme outer end of the oosphere, so that there is hardly a doubt that they have passed from the pollen tube between the neck-cells of the archegonium. The nucleus of the fertilized oosphere *clothes itself* with a layer of very large starch grains which disappear during its movement to the lower end of the oosphere or shortly thereafter. These starch grains were formerly thought to be inside the nucleus of the oosphere.

IV. In the fertilization of Angiosperms there remains only one step to be observed, viz., the passage of the nucleus of the male cell of the pollen grain into the oosphere. In many monocotyledons, especially Orchideæ and Liliaceæ, the transparency of the ovules and the comparatively large size of the nuclei in the pollen tubes renders the process much more easily observed than in dicotyledons, in which these two conditions seldom co-exist. The processes are, however, essentially alike in both. In the pollen tube the generative nuclei can be recognized even to the time when the tube enters the ovule. In those cases when the vegetative nucleus goes first (some monocotyledons), it is probable that it can and does copulate with the oosphere, though it has never been seen inside the integument of the ovule. When the pollen tube reaches the micropyle it penetrates to the embryo sac and inserts its apex between the caps of the synergidæ. One or both of the synergidæ then become disorganized, thus making way for the plasma of the pollen tube to reach the oosphere. The generative nuclei can then be seen between the synergidæ; one of them, the male pronucleus, penetrates the oosphere and fuses with its nucleus, the female pronucleus. The other soon becomes absorbed. The nucleoli of the male and female pronuclei likewise fuse, and a delicate cellulose wall is formed on the fertilized oosphere.

V. The author states his new theory of fertilization in three propositions which he considers well established.

1. The process of fertilization consists in the union of the male pronucleus with the nucleus of the oosphere, a statement which was first definitely formulated by O. Hartig.

2. The cytoplasm is not concerned in the process of fertilization.

3. The male pronucleus, like that belonging to the oosphere, is a genuine nucleus.

In confirmation of the last proposition it has been established by direct observation that, although usually the male pronucleus undergoes more or less important changes in its course to the embryo, thus casting doubt upon its nuclear nature, yet in some cases it proceeds without such changes even up to the time of copulation. When the nucleus meets with resistance on its way to the oosphere, there are coincident changes especially when surrounded by but little cytoplasm. The more the enveloping cytoplasm, the less change in the nucleus, the changes being reduced to their minimum in phanerogams.

The second proposition, which makes the protoplasm surrounding the pronuclei only incidental in the process of fructification, has given rise to much controversy. It is undoubtedly necessary to look to the angiosperms to clear up this important point. In the division of the progamous pollen cell the cytoplasm of the resulting generative cell, even when in the smallest quantity, is seen to be strongly defined. It is evident that this cytoplasm might possess procreative qualities if it retained its identity up to the time of copulation. But we find on the one hand that it is as good as consumed by the generative nucleus and so often quite disappears, and then on the other hand that the boundary of the cell may entirely vanish sooner or later. Just here a difference exists between gymnosperms and angiosperms in that the nucleus of the generative cell of the former only uses up a part of the cytoplasm of its cell, while the latter may consume it all. From this and other arguments it is concluded that the procreative power can not reside in the cytoplasm. The cytoplasm of the generative cell in gymnosperms and of the vegetative cell in angiosperms serves in part as a vehicle to transport the nucleus, and therefore performs the same office as the cilia of the antherozoids in the vascular cryptogams.

The first proposition naturally follows from what has been said, for if the cytoplasm is not concerned in fructification, the pronuclei—male and female—must necessarily be the agents. The author does not, however, rest the question upon this *reductio ad absurdum* proof, but proceeds to give with the greatest detail every item of the process of fructification with the accompanying changes. He then discusses many recondite questions connected with the physics and physiology of the process, bringing to bear the latest investigations of the similar processes in zoology, such as those of Balfour,* Nussbaum,† and Ed. van Beneden and Ch. Julin.‡ Over eighty pages are devoted to this theme, so packed with new and important matter that it is entirely impossible to give a profitable abstract in the space at command.

Die Pilzthiere oder Schleimpilze, nach dem neuesten Standpunkte bearbeitet. Von Dr. W. Zopf. Eduard Trewendt. Breslau, 1885. Roy. 8°., pp. 174. Illustrated.

In this exceedingly interesting work the author has given the results of his own earnest and patient labor and also quoted freely from the writings of De Bary, Cienkowski, Klein, Brefeld, VanTieghem and other investigators in the same field.

In his opening chapter he makes a comparison of the morphology of the Monadines with the morphology of the Eumycetozoa, and is led to the conclusion that the representatives of both groups are substantially similar in their early development, and that between them bonds of union exist.

In regard to the place of this combined group of Mycetozoa in the system of organic life, it occupies, without doubt, a peculiar position, a borderland between the animal and vegetable kingdoms, a view which the author has expressed in the words of the title. He also prefers on this account DeBary's term, Mycetozoa, to Myxomycetes, as being more literally correct.

The first division of the book is devoted to morphology and life history, giving in detail the development of individual members of the group from the germiuation of the spore through the successive stages of zoospores, amœbæ and plasmodium, and finally the matured zoocysts and sporocysts.

* Handbook of Comparative Embryology.
† Arch. f. mikr. Anat., Bd. xxiii.
‡ On the spermatozoids of *Ascaris megalocephala*, in Bull. de l' Acad. roy. de Belgique, ser. 3, vii.

In the second division is given the physiology of the group, which includes detailed accounts of the behavior of the plasmodium under light, electricity and various temperatures, and also when subjected to the influence of different gases and chemical re agents. A chemical analysis of plasmodium of *Fuligo varians* (after Reinke and Rodewald), furnishes a large and curious list of component parts.

In the third division is the systematic classification with descriptions of one or more species of each genus represented. The heads of the author's classification are as follows:

A. Monadineæ.
  I. *M. azoosporeæ* Z.
    1. Vampyrelleæ. 2. Bursullineæ. 3. Monocystaceæ.
  II. *M. zoosporeæ* Cienk.
    1. Pseudosporeæ. 2. Gymnococcaceæ. 3. Plasmodiophoreæ.
B. Eumycetozoa.
  I. Sorophoreæ.
    1. Guttulineæ. 2. Dictyosteliaceæ Bref.
  II. Endosporeæ.
    a. Peritricheæ.
      1. Clathroptychiaceæ Rost. 2. Cribrariaceæ Rost.
    b. Endotricheæ.
      a. Stereonemeæ.
        1. Calcariaceæ Rost. 2. Amaurochætaceæ Rost.
      b. Coelonemeæ.
        1. Trichiaceæ Rost. 2. Arcyriaceæ Rost. 3. Reticulariaceæ Rost. 4. Liceaceæ Rost. 5. Perichænaceæ.
  III. Exosporeæ Rost.

As Rostafinski's classification of the Myxomycetes or Eumycetozoa was perhaps universally adopted after the appearance of his monograph, botanists will probably be interested in noting the changes suggested by Dr. Zopf.

As a result of some recent investigations, he deems it necessary to make changes in some of the groups founded upon the color of the spores. The orders and sub-orders, with some omissions, are otherwise substantially the same except the order Heterodermeæ, which is replaced by Peritricheæ, the sub-order Clathroptychiaceæ, being also included.

The following Rostafinskian genera are omitted: Protoderma, Cienkowskia Crateriachea, Chondrioderma, Echinostelium, Brefeldia, Heterodictyon, Siphostychium, Dermodium, Oligonema and Prototrichia.

While botanists may not question the wisdom of the abandonment of some of the above genera, it seems to be a rather vigorous use of the pruning knife to merge Chondrioderma with Didymium on the ground of similarity of capillitium, especially as Lepidoderma with the same character of capillitium is retained.

Two new genera are created, Æthaliopsis and Tubulifera, each with a single species.

The work is well illustrated with fifty-two wood cuts, mostly by the author, and is a welcome addition to the literature of the subject. GEO. A. REX.